by Spence Driver

Balancing for amino acids can pay off

THE ideal protein concept is not new to the livestock industry. Poultry and swine nutritionists have used these strategies for many years. The premise behind the ideal protein concept is that, by identifying the amino acids likely to limit milk protein synthesis and boosting the concentration in the diet, all other amino acids are used more efficiently. Thus, a smaller package of dietary protein is needed. The benefits of the ideal protein concept are to:

- Reduce excessive quantities of expensive rumen undegradable protein sources (RUP).
- Reduce nitrogen excretion. Cows utilize valuable energy when converting excess nitrogen and amino acids to urea for elimination by excretion.
- Environmental. Glenn Broderick at the United States Dairy Forage Research Center stated in a previous article (March 25, 2004 issue, page 214), "Nearly all of the nitrogen in the extra dietary protein that was not captured as milk protein ended up in the urine, the form that causes the most problems in the environment."
- Free up space in the diet for other nutrients, primarily fiber and energy.

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What likely is short . . .

First-limiting amino acids are those that are in shortest supply relative to requirements. Methionine and lysine generally are considered the first-limiting amino acids for milking herds. They are most limiting because only a small number of feeds have concentrations of either lysine or methionine that are as high as the concentrations observed in milk and bacterial protein. Until the introduction of commercially available rumen protected methionine sources, it was not possible to raise both metabolizable lysine and methionine concentrations significantly through feed supplements..

Amino acid nutrition for cows is more complicated than for pigs and chickens due to the involvement of rumen microbes. There still is some reluctance in the dairy industry to put the principles of amino acid nutrition into practice. We need more research before dairy cattle diets can be balanced for amino acids with the precision possible for nonruminants. Nevertheless, we've made enough progress to make improvements in a predictable fashion that allow for improved utilization of protein and, therefore, improved efficiency.

Can improve efficiency . . .

Computer models have advanced to the point of predicting how well a diet supplies protein and amino acids for milking herds. Chuck Schwab, University of New Hampshire says, "Although these models are far from perfect, they represent big steps forward in evaluating diets for rumen degradable protein (RDP), rumen undegradable protein (RUP), and amino acids and have been useful for improving the efficiency of conversion of feed crude protein to milk protein on many dairy farms."

Here are some considerations when using a protein and amino acid model:

- Make sure animal, production, and feed inputs are accurate.
- Don't shortchange cows on rumen degradable protein.
- Don't overfeed rumen undegradable protein.
- Strive to maximize concentrations of both lysine and methionine while maintaining a 3:1 ratio.

There are many good reviews in the literature summarizing the benefits of balancing amino acids for cows in milk. Brian Garthwaite and his co-workers at the University of New Hampshire (1998) reviewed what happened during the first third of lactation when researchers fed lysine and methionine concentrations above those typically fed in dairy rations. Average responses from seven trials were:

- 3.74 pounds per day gain in milk yield
- 0.10 percent boost in milk protein concentration
- 0.2 pound higher milk protein yield
- 0.10 percent gain in milkfat
- 0.21 pound benefit in milkfat yield

While amino acid formulation looks good in theory, does it work on the farm? We have been evaluating amino acid nutrition for about six years. Originally, we ran a commercial field trial in conjunction with the University of Wisconsin. Nineteen high-yielding herds participated (RHA's av-

eraged 23,610 pounds milk).

By balancing for amino acids, we were able to reduce crude protein from 17.6 percent to 16.8 (dry matter basis). ADF, NDF, and NFC levels were elevated slightly as a result of space available after lowering protein in the amino acid-balanced rations. At any time during the test period, half of the herds were fed an amino acid balanced diet, and half were on the preexisting ration. We did this to avoid any seasonal effects. Table 1 shows the production results.

Trimmed feed costs . . .

The focus of the trial was to lower ration crude protein and feed cost without affecting performance. A trend for improvement in protein concentration was the only difference due to amino acid balancing. We saw no other changes in production, but feed cost was reduced by an average of 5 cents per cow per day as a result of the reduced protein.

Amino acid balancing increased consumption of homegrown feeds rather than purchased feeds. Purchased feed costs dropped 10 cents per cow per day. The trial clearly demonstrated amino acid balancing can improve profitability.

More recently, I have been using the NRC model to fine-tune rations to improve protein efficiency. Table 2 shows the dietary changes, and Table 3 shows the production results of two commercial herds before and after amino acid balancing.

Dry matter intake did not change during the field trial. Herd A and B consumed 54 and 53 pounds, respectively. Herd A saw a 1-pound gain in milk yield and a 0.1 percent improvement in true protein. Based on current feed costs and pay price, Herd A experienced a 2:1 return on investment.

My goal in Herd B was to adjust the ration and lower feed cost without affecting production. This farm always has relatively high intakes for the level of milk produced. Thus, the model should allow me to attain my goal by adjusting the diet to improve protein efficiency. Note that we were able to lower crude protein in the diet to 16 percent without sacrificing production. Yet, we still saw an improvement in milk protein concentration and lowered feed cost by 5 cents per cow per day. Herd B experienced a 1.8:1 return on investment based on current feed costs and pay price.

Is amino acid balancing for everyone? Probably not at this time. Some farms may have other issues to address before amino acid balancing.

What does amino acid balancing have to offer? Balancing for amino acids can benefit you in a number of ways:

- Raise production of both milk and milk protein at minimal cost.
- Lower total protein content of the diet and, thus, lower diet cost.
- Reduce nitrogen excreted into the environment.
- Provide more predictable milk performance.
- Improve your margins.

Table 1. Production results in 19 herds

	Existing*	Amino acid**	Difference***
Milk, lbs.	74.60	74.80	No
Fat, lbs.	2.77	2.72	No
Fat, %	3.79	3.70	No
Protein, lbs.	2.39	2.42	No
Protein, %	3.24	3.29	Yes

* Without ration changes
** With amino acid ration balancing
*** Whether difference was significant (p<.01)0

Table 2. Ration profile of two herds before and after amino acid balancing

	Herd A		Herd B	
Item	Old diet	New diet	Old diet	New diet
Neutral detergent fiber	29.6	29.7	29.9	30.2
Crude protein	17.8	16.9	17.3	16.0
Rumen degradable protein	12.0	11.5	11.6	10.5
Rumen undegradable protein	5.8	5.4	5.7	5.6
RDP balance g/d	448	329	394	103
RUP balance g/d	91	1	118	71
MP balance g/d	75	1	94	56
Lys, %MP	6.51	6.56	6.68	6.72
Met, %MP	1.92	2.18	1.92	2.12

MP = metabolizable protein

Table 3. Production and feed costs of two herds before and after amino acid balancing

	Herd A		Herd B	
Item	Old diet	New diet	Old diet	New diet
Milk lbs./d	85.0	86.0	75.0	75.0
True protein %	2.94	3.04	2.95	3.00
Protein lbs./d	2.50	2.61	2.21	2.25
Fat %	3.70	3.70	3.80	3.80
Fat lbs./d	3.12	3.18	2.85	2.85
Ration cost		+ $0.12		- $0.05
Return on investment		2:1		1.8:1